

Introduction

Studies on the bio-inventory and ecosystem valuation document the ecosystems services in economic terms which makes it easily interpreted by policy makers and executives. Economic valuation of coastal ecosystems is essential for environmental planning and management, which ultimately leads to sensible use of coastal resources and services. Karnataka is one of the major maritime states on the south west coast of India. In this research, an attempt was made to understand the biodiversity and the economic value of coastal ecosystems of Karnataka to highlight its Provisional Services, Regulatory Services, Supporting Service and Cultural/spiritual services for biodiversity conservation and management.

Methodology

Study area: The study was conducted in the coastal district of Karnataka *ie* Dakshina Kannada, Udupi and Uttara Kannada. A Rapid Biodiversity Survey conducted along the coastal taluks of these districts (Fig. 1.)

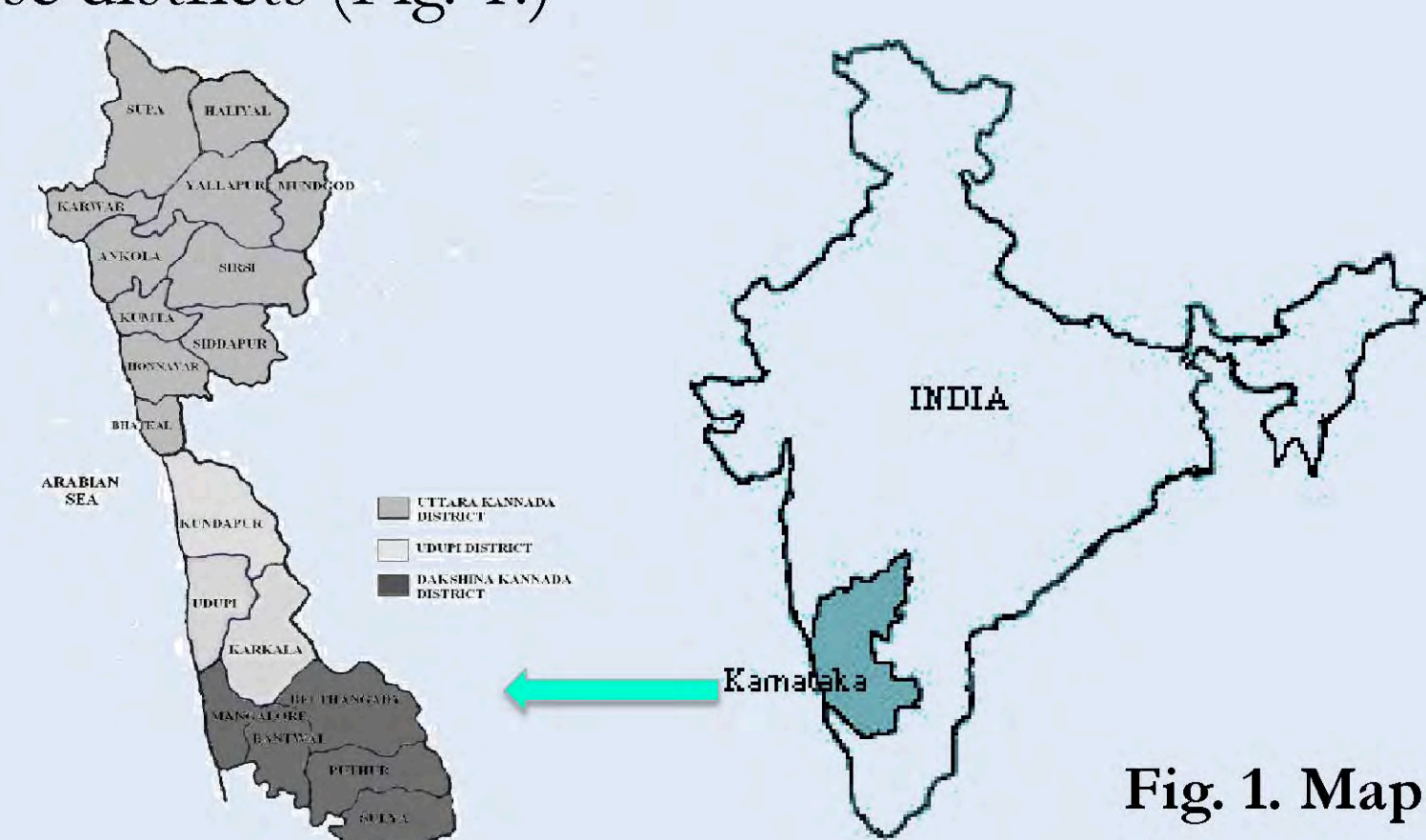


Fig. 1. Map showing the survey site

Data collection: The study was based on primary as well as secondary data. The research was initiated by holding informal discussions with different stakeholders like local residents including fishers, officials of the forest/agriculture/fisheries department, members of local self-governments and elderly people in the locality and also by direct observations during field visits. The data was gathered from 235 respondents belonging to above identified stakeholder groups selected through simple random sampling method. Data was collected through personal interview using structured pretested interview schedule along with direct observation.

Economic valuation: The Total Economic Value (TEV) conceptual framework views ecosystem goods and services as the flow of benefits to mankind by nature. Since there were vast natural capital and ecosystem services under consideration in the present study two methods were simultaneously used. Direct method (Market Based and Cost Based Method) and Indirect method (Revealed Preference Method- Travel Cost Method and Stated Preference Method - Willingness to Pay (WTP)) were used for valuation. The method of Costanza *et al.* (1997, 2011) was also followed to determine the ecosystem service value (ESV).

Results

The Karnataka State lies between 12°45'9.78"N and 18°22'53.88"N to 74° 5'25.09"E and 78°13'26.03"E. The coastal zone in Karnataka is having a coastline of 320 km from Ullal to Majali with 27,000 sq.km of continental shelf and 87,000 sq.km of Exclusive Economic Zone. The state has 5.20 lakh hectares of inland water resources comprising of 2.93 lakh hectares of major and minor tanks, 2.67 lakh hectares of reservoirs and 5813 km length of rivers. Karnataka coastal region has 13 main rivers drain into it – Nethravati, Gurupur, Udiyavara, Mulki and Pavange, Sita and Swarna, Haladi, Chakra, Kollur and Baindur, Kalinadi, Gangavali, Aghanashini, Sharavathi and Venktapur. There are 26 estuaries with more than 70,000 Ha. of water-spread area and 8000 Ha of brackish water area, making the three coastal districts of Karnataka very rich in marine, estuarine and riverine biodiversity.

Table 1. Table showing the stretch of coastal ecosystems in Karnataka

Districts	Lagoons	Creeks	Sand/ Beach	Intertidal mud flats	Mangroves	Salt pans	Aquaculture ponds
Dakshina Kannada	-	-	365	62	82	-	35
Udupi	50	37	543	130	501	-	517
Uttar Kannada	22	60	989	1471	384	812	222
Total	72	97	1897	1663	967	812	774
*All values are in Hectare(Source : National Wetland Atlas: Karnataka, 2010)							

Coastal Biodiversity

The coastal ecosystem of Karnataka is highly diverse with the presence of phytoplankton (62 spp.), seaweeds (78), zooplankton (115), sponges (6), sea anemones (25), and polychaetes (143), gastropods (145), bivalves (70), shrimp (33), crab (103), cephalopods (16), sea grasses (2), bryozoans (3), scaphopods (2), polyplacophores (1), Starfishes (5), Sea urchins (2) and sea cucumber (1). A total of 390 marine fish species belonging to 24 orders and 118 families were collected and identified from the coast, which forms 15.3% of the marine fishes reported from Indian coast. Sea turtles (3 spp.), and sea snakes (3), whales (4), dolphins (4) and porpoise (1) were generally seen along the Karnataka coast. There is a rich fringing coral reef ecosystem surrounding the Netrani Island located nearly 19 km away from the main land off Murdeshwar. fourteen coral species and four sponge species have been identified from the island. Dakshina Kannada and Udupi districts harbour about 366 bird species. Uttara Kannada alone is home to 424 species of birds. There are 103 species of butterflies and 52 species of dragonflies and damselflies were recorded from coastal districts of Karnataka. The mangrove diversity based on surveys conducted on 11 estuaries shows the occurrence of 14 species along the Karnataka coast.

Economic valuation of ecosystems of coastal Karnataka

Sl. No.	Value of Services	Value in Million US \$	Value in Crore (INR)
1.	Value of estuaries in Karnataka	2192.1	14265.98
2.	Value of mangroves in Karnataka	203.0	1321.12
3.	Value of continental shelf of Karnataka	6015.9	39151.64
4.	Value of commercial fishery of Karnataka.	683.7	4443.77
5.	Value of sand mining in coastal Karnataka	130.8	850
6.	Value of salt production in coastal Karnataka	5.1	33
7.	Value of ecosystem services from Karnataka EEZ	6218.4	40469.43
8.	Willingness to pay for the protection of threatened resources	235.7	1532
9.	Tourism value	1417.8	9216
10.	Value of the ecosystem services by flood plains and marshes	46.3	301
11.	Value of island ecosystem having fringing reef	3.8	24.83
12.	Value of sea mount area	498827.0	3252289
13.	Capital investment in Karnataka fisheries	78.5	510.31
14.	Value of ecosystem services by sand dunes in	1732.9	1126.38
15.	Value of coastal wet lands in fresh water supply	909.6	5912
	Total	518700.6	3371446.46



Conclusion

The approximate value was estimated for the coastal ecosystem services and natural capital of Karnataka Coast is 518.70 billion US dollars per year (on April, 2017). This value is observed to be 2.6 times more than the GDP of Karnataka in the year 2015, which signifies the importance for the conservation and judicious management of the natural resources.

Acknowledgement

The authors are thankful to the Director, ICAR-CMFRI Cochin, for facilitating the study.

Reference

- Costanza, R., d'Arge, R., De Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R.V., Paruelo, J. and Raskin, R.G., 1997. The value of the world's ecosystem services and natural capital. *nature*, 387(6630), pp.253-260.
- Costanza, R., Kubiszewski, I., Ervin, D., Bluffstone, R., Boyd, J., Brown, D., Chang, H., Dujon, V., Granek, E., Polasky, S. and Shandas, V., 2011. Valuing ecological systems and services. *F1000 Biology Reports*, 3.
- NWA ., 2010. National Wetland Atlas: Karnataka, SAC/RESA/AFEG/NWIA/ATLAS/16/2010, Space Applications Centre, ISRO, Ahmedabad, India, 192pp